

---

---

स्थायीकृत मृदा के ब्लॉक का निर्माण —  
मार्गदर्शी सिद्धांत

Manufacture of Stabilized Soil  
Blocks — Guidelines

ICS 91.100.15

© BIS 2020



भारतीय मानक ब्यूरो  
BUREAU OF INDIAN STANDARDS  
मानक भवन, 9 बहादुरशाह ज़फर मार्ग, नई दिल्ली – 110002  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI-110002  
[www.bis.gov.in](http://www.bis.gov.in) [www.standardsbis.in](http://www.standardsbis.in)

## FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Clay and Stabilized Soil Products for Construction Sectional Committee had been approved by the Civil Engineering Division Council.

This standard covers guidelines for manufacture of stabilized soil blocks. Soil represents the earliest construction material used by mankind. Pure mud constructions suffer from two major drawbacks, complete loss of strength on saturation and erosion due to rain impact. Soil is therefore stabilized to improve its strength properties and durability and the stabilized soil is used for various engineering applications. Stabilized soils have been successfully used for the construction of roads, pavements, foundations, earthen bunds, etc, in the past. Use of stabilized soils for the construction of walls of buildings can be seen since thirties. Large numbers of buildings using stabilized soil blocks have come up in many parts of the world including India. This is mainly attributed to the fact that stabilized soil block is energy efficient and a low carbon emission alternative to burnt clay brick and concrete based blocks. Currently large varieties of machines are commercially marketed throughout the world for the production of stabilized soil blocks.

The Indian Standard IS 1725 : 2013 ‘Stabilized soil blocks used in general building construction — Specification (*second revision*)’ deals with requirements for general quality, dimensions and physical requirements and testing methods for the stabilized soil blocks for use in general building construction. Varieties of machines (both mechanized and manually operated) are used for the manufacture of compacted stabilized soil blocks. Use of these machines has led to production of stabilized soil blocks of higher compressive strength, proper dimensions and precise edges and has also lead to better block productivity. Both modular and non-modular sizes of stabilized soil blocks are being manufactured in the country.

In order to promote and guide in the manufacture of these types of blocks aiming at sustainable construction, this standard has been formulated.

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*).’

## *Indian Standard*

# MANUFACTURE OF STABILIZED SOIL BLOCKS — GUIDELINES

## 1 SCOPE

This standard covers guidelines for manufacture of stabilized soil blocks.

## 2 REFERENCES

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

| <i>IS No.</i>        | <i>Title</i>                                                                                                                            |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| 1725 : 2013          | Stabilized soil blocks used in general building construction — Specification ( <i>second revision</i> )                                 |
| 2248 : 1992          | Glossary of terms relating to clay products for buildings ( <i>second revision</i> )                                                    |
| 2720 (Part 7) : 1980 | Method of tests for soils: Part 7 Determination of water content-dry density relation using light compaction ( <i>second revision</i> ) |

## 3 TERMINOLOGY

For the purpose of this standard, the terms and definitions given in IS 2248 and IS 1725 and the following shall apply.

**3.1 Soil Stabilization** — A general term for any physical, chemical, biological, or combined method of changing natural soil to meet an engineering purpose that increases and maintains its stability in order to obtain enhanced lasting properties and strength.

**3.2 Stabilized Soil Block** — A soil block manufactured from a mixture of suitable soil-sand mixture and stabilizers, such as cement and lime, compacted into a high-density block at optimum moisture content followed by curing.

## 4 MATERIALS

Materials used, such as cement, lime, sand, soil and water shall be as given in IS 1725.

## 5 DIMENSIONS AND TOLERANCES

The dimensions and tolerances of stabilized soil blocks shall be as given in IS 1725.

## 6 MANUFACTURING PROCESS

A typical process flow diagram giving the different steps involved in the manufacture of the stabilized soil blocks is given at Fig. 1. Machines (manual, semi-automatic or fully automatic) shall be employed for the manufacture of stabilized soil blocks. Brief details of these steps involved in the manufacture, are given in 6.1 to 6.10.

### 6.1 Excavation and Transportation of Soil

The top surface (150 - 200 mm) of the ground identified as a source for soil should be scrapped in order to remove organic matter, such as roots and leaves. The excavated soil is transported to the block manufacturing unit for further processing. The volume of soil needed to produce one cubic metre of stabilized soil blocks depends on the clay fraction of the soil and soil-sand ratio to arrive at optimum clay content yielding maximum strength.

### 6.2 Sieving Soil and Sand

The dry soil and sand should be sieved through a simple mesh of 4 to 5 mm to eliminate bigger soil lumps and gravels. Figure 2 shows a typical flat screen sieve and rotary sieve which can be used for sieving.

### 6.3 Mixing of Materials

Sieved soil, sand and stabilizer (such as cement and lime) should be thoroughly mixed to ensure uniform distribution of stabilizer in the mixture (*see Note*). Mix the soil and sand first and then mix it with the stabilizer. These mixing operations should be carried out in dry state either manually or using suitable machine, such as concrete mixer or pan mixer.

NOTE — The recommended soil or soil-sand mixture and ratio of stabilizer to clay for expansive and non-expansive soil are given in IS 1725.

### 6.4 Moulding Water Content

The dry soil-sand-stabilizer mixture shall be mixed with optimum quantity of water (*see Note*). Optimum quantity of water to be used depends upon the workability of the wetted mix. The workability should be such that the wet mix does not stick to the machine mould while ejecting the block and should have enough green strength to handle. The standard proctor optimum moisture content of the mix, based on IS 2720 (Part 7) gives only guidance value for the optimum moisture content. Soil mixtures outlined in IS 1725 result in optimum clay content of about 12 to 15 percent. For such soil mixtures, the optimum

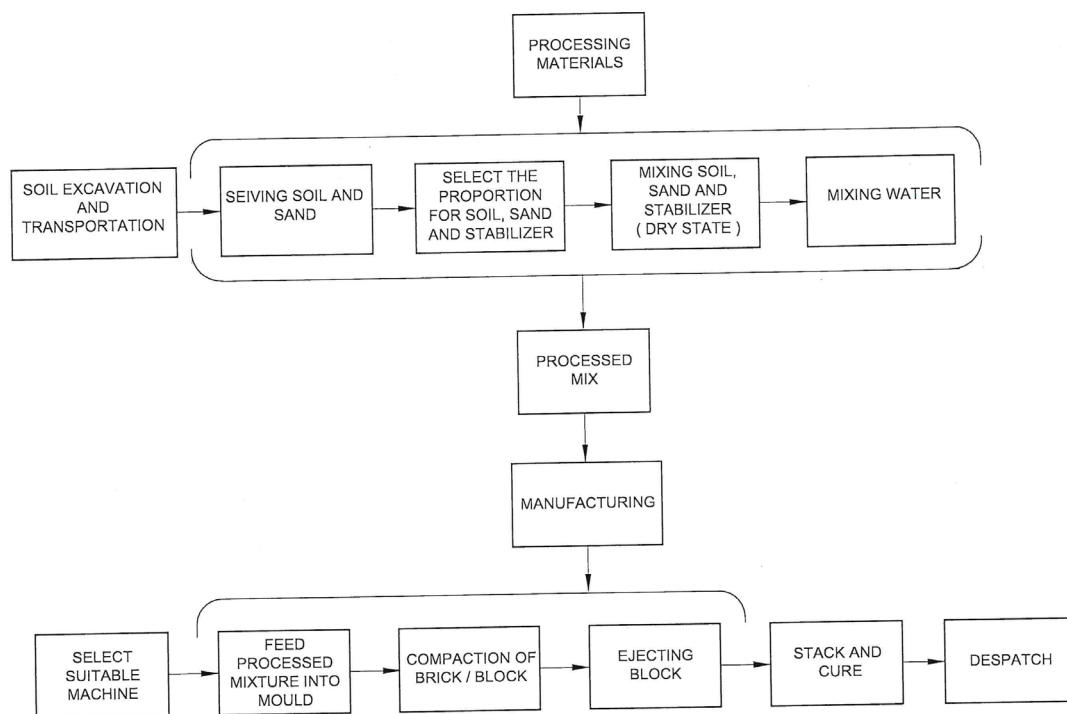


FIG. 1 A TYPICAL PROCESS FLOW DIAGRAM FOR STABILIZED SOIL BLOCK PRODUCTION

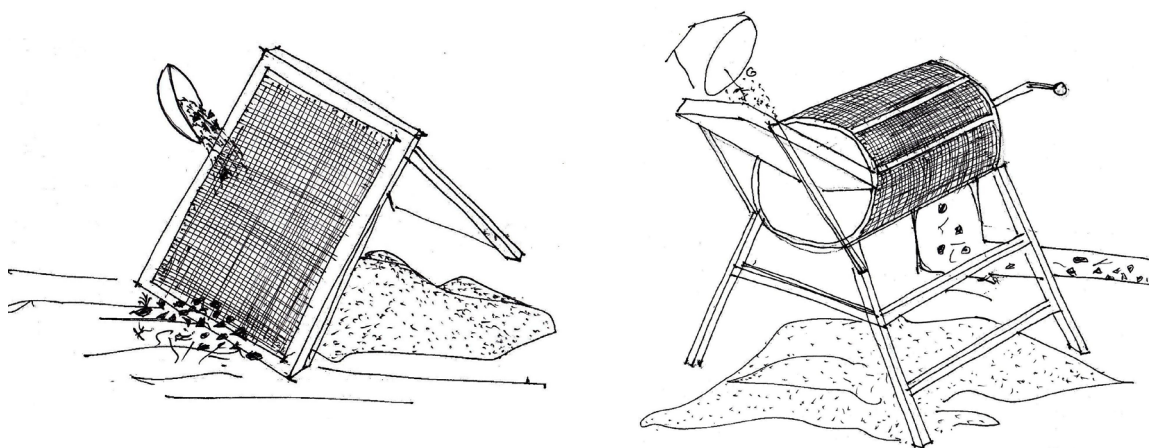


FIG. 2 PICTORIAL REPRESENTATION OF FLAT SCREEN SIEVE (LEFT) AND ROTARY SIEVE (RIGHT)

moulding water content lie in the range of 10 to 12 percent. Mixing of requisite quantity of water shall be carried out either manually or using a suitable machine, such as pan mixer. Uniform mixing of water shall be ensured, and formation of wet soil lumps should be avoided. Fresh mix should be used, and the mix shall be consumed within 45 min.

NOTE — Optimum quantity of water does not depend upon the proctor optimum moisture content. The compaction process used for compacting the stabilized soil blocks is

a static compaction process whereas standard proctor test employs dynamic compaction with a fixed amount of compaction energy input.

### 6.5 Dry Density of the Block

The block characteristics greatly depend upon dry density of the stabilized soil block. Block density should be controlled by controlling the mass of the fresh wet mix getting into the machine mould. Dry density of the block should be greater than  $1\,750\text{ kg/m}^3$ .

### 6.6 Block Moulding and Compaction

The block production operation involves feeding the partially wetted stabilizer-soil mixture into the machine mould, compaction through piston movement, ejecting, conveying and stacking. A machine is required to achieve proper compaction and density. Manually operated or semi-automatic or fully automatic machine may be used for the block moulding, compaction and manufacture of stabilized soil blocks. All these machines employ static compaction process for achieving the requisite dry density for the block.

The compaction ratio (that is, ratio between the heights of the loose soil in the mould and the compacted block) for the machine shall not be less than 1.70. Figure 3 illustrates the generic steps involved in the static compaction process. The maximum density that can be achieved employing manual machines is restricted to about 1800 kg/m<sup>3</sup>. In such machines, the block thickness should be restricted to 100 mm or less, as thickness beyond 100 mm results in variation in the block density across the block thickness in the static compaction process.

### 6.7 Stacking the Blocks

The stacking yard is a levelled ground surface created using either sand or soil. The blocks shall be stacked (see Fig. 4) closely without gaps between the adjacent blocks, one above the other up to 6 blocks height. The stack of blocks shall be covered with a wet Hessian cloth or straw or similar material and the stack shall be under shade avoiding direct exposure to sunlight.

### 6.8 Curing the Blocks

The curing of blocks shall commence after 24 h from the time of manufacture. Sprinkle water on the stack and keep the entire stack of blocks always under moist condition by covering with a layer of sacking, hessian or an impermeable membrane such as polythene sheeting

for at least 28 days. The curing duration shall continue till the block acquires requisite wet compressive strength. The curing operation shall be carried under shade without exposure to direct sunlight. Cured blocks shall be air dried and then used for construction. Accelerated curing techniques such as steam curing may also be adopted.

### 6.9 Controlling the Block Density

The compressive strength of the stabilized soil block depends upon its dry density. Therefore, it is essential to control the dry density of the block. Annex C of IS 1725 gives the procedure for determining the dry density of stabilized soil block. The dry density should be controlled during the manufacturing process of the block. Weigh batching of the fresh wetted mix of soil and stabilizer fed into the machine mould is required for controlling the density. Mass of the mix to be fed into the machine mould shall be calculated using the following relationship:

$$W_f = (V)(\gamma_d)(100 + w)/100$$

where,

$W_f$  = Mass of fresh mix per block, in kg;

$V$  = Volume of the block, in m<sup>3</sup>;

$\gamma_d$  = Dry density of the block, in kg/m<sup>3</sup>; and

$w$  = Moulding water content, in percent.

**6.10** Blocks of special shapes, such as rounded corner, corbelled or any other shape for the purposes of enhancing aesthetic appearance of masonry and the building can be manufactured with special attachments to the machines. Figure 5 shows some typical shapes of stabilized soil blocks.

## 7 CONTROLLING BLOCK QUALITY

The block quality greatly depends upon the optimum clay content, block density and the stabilizer content.

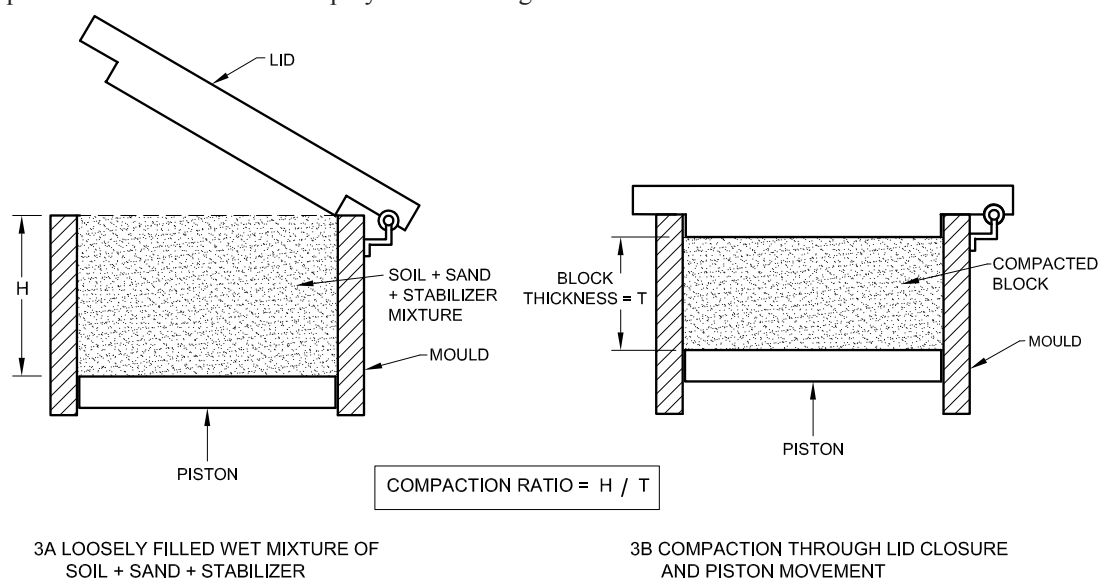


FIG. 3 STATIC COMPACTION PROCESS EMPLOYED FOR BLOCK MANUFACTURE

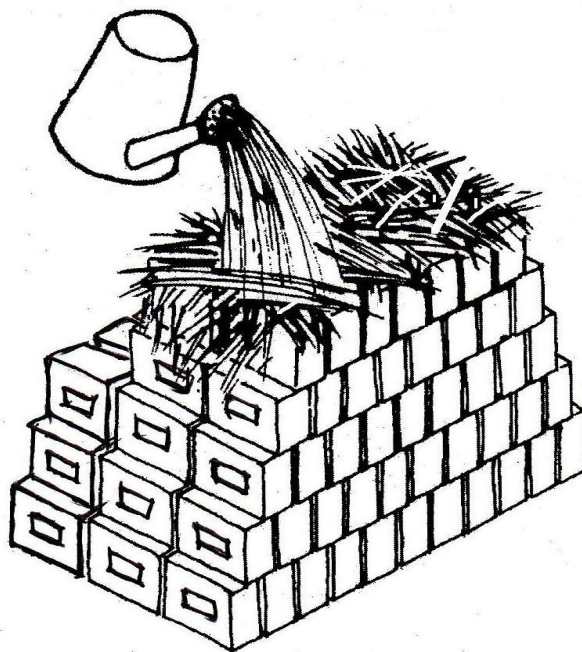


FIG. 4 STACK OF STABILIZED SOIL BLOCKS READY FOR CURING

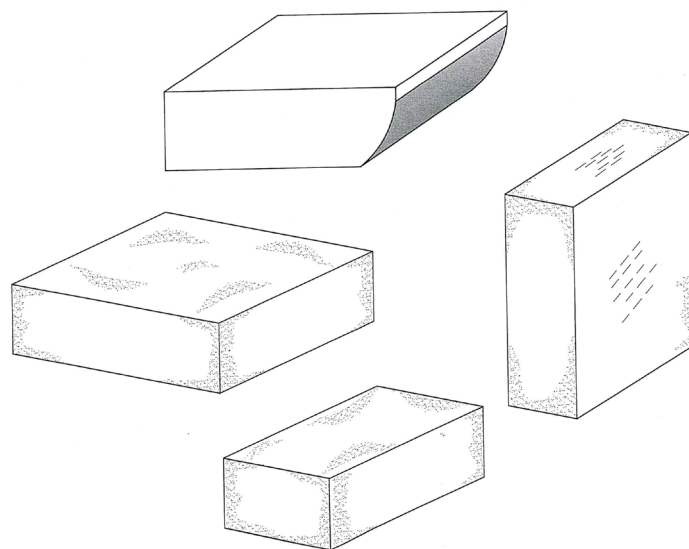


FIG. 5 SOME TYPICAL SHAPES OF STABILIZED SOIL BLOCKS

The essential requirements for the block, from the consideration of durability aspects are mass loss in the weathering test, linear expansion on saturation and the water absorption. The limits for these requirements are as specified in IS 1725. Controlling the optimum clay content, block density and the stabilizer content in accordance with the requirements given in IS 1725 will ensure the block quality. The block strength can be easily controlled by controlling the stabilizer content.

## 8 FREEDOM FROM DEFECTS

**8.1** Blocks shall be of homogeneous colour and texture.

**8.2** Blocks should be free from cracks, pits, broken edges, honey comb and other defects that would interfere with the proper placing of blocks or impair the strength or performance of construction.

**8.3** Blocks should be reasonably free from surface flaws, laminations, crumbly and imperfect edges.

**ANNEX A***( Foreword )***COMMITTEE COMPOSITION**

Clay and Stabilized Soil Products for Construction Sectional Committee, CED 30

| <i>Organization</i>                                                                            | <i>Representative(s)</i>                                                 |
|------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| In Personal Capacity (C/o CSIR-Central Building Research Institute, Roorkee)                   | DR A. K. MINOCHA ( <b>Chairman</b> )                                     |
| All India Brick & Tile Manufacturers Federation, New Delhi                                     | SHRI R. P. S. CHANDEL<br>SHRI R. K. VERMA ( <i>Alternate</i> )           |
| Auroville Earth Institute, Auroville                                                           | REPRESENTATIVE                                                           |
| Building Materials & Technology Promotion Council, New Delhi                                   | SHRI SHARAD GUPTA<br>SHRI PANKAJ GUPTA ( <i>Alternate</i> )              |
| Central Pollution Control Board, New Delhi                                                     | SHRI B. VINOD BABU                                                       |
| Central Power Research Institute, Bengaluru                                                    | REPRESENTATIVE                                                           |
| Central Public Works Department, New Delhi                                                     | CHIEF ENGINEER (CSQ)<br>SHRI MATHURA PRASAD ( <i>Alternate</i> )         |
| Central Soil and Materials Research Station, New Delhi                                         | SHRI U. S. VIDYARTHI<br>SHRI B. K. MUNZNI ( <i>Alternate</i> )           |
| CSIR-Advanced Materials & Processes Research Institute, Bhopal                                 | DR R. K. MORCHHALE<br>DR MANISH MUDGAL ( <i>Alternate</i> )              |
| CSIR-Central Building Research Institute, Roorkee                                              | DR L. P. SINGH                                                           |
| CSIR-Central Glass & Ceramic Research Institute, Kolkata                                       | DR PARVESH AGRAWAL<br>SHRIMATI ASHA T. ANIL ( <i>Alternate</i> )         |
| CSIR-North-East Institute of Science and Technology, Jorhat                                    | DR PINAKI SENGUPTA                                                       |
| Delhi Development Authority, New Delhi                                                         | CHIEF ENGINEER (DESIGN)<br>SHRI LACHHMAN SINGH ( <i>Alternate</i> )      |
| Delhi Metro Rail Corporation, Delhi                                                            | SHRIMATI PAPIYA SARKAR                                                   |
| Development Alternatives, New Delhi                                                            | DR SOUMEN MAITY<br>SHRI PALAS KUMAR HALDAR ( <i>Alternate</i> )          |
| Greentech Knowledge Solution, New Delhi                                                        | DR SAMEER MAITHEL<br>SHRI SONAL KUMAR ( <i>Alternate</i> )               |
| Gujarat Engineering Research Institute, Vadodara                                               | SHRI B. M. RAO<br>SHRI KAMALANAYAN L. DAVE ( <i>Alternate</i> )          |
| Hindustan Construction Company Ltd, Mumbai                                                     | SHRI SATISH KUMAR SHARMA<br>SHRI RAJIV SUREKHA ( <i>Alternate</i> )      |
| Housing and Urban Development Corporation Limited, New Delhi                                   | SHRI AKHILESH KUMAR<br>SHRI SURENDRA KUMAR ( <i>Alternate</i> )          |
| Indian Institute of Science, Bengaluru                                                         | DR B. V. VENKATARAMA REDDY<br>DR K. S. NANJUNDA RAO ( <i>Alternate</i> ) |
| Int Nirmata Parishad, Varanasi                                                                 | REPRESENTATIVE                                                           |
| Military Engineer Services, Engineer-in-Chief's Branch, Integrated HQ of MoD (Army), New Delhi | SHRIMATI UPINDER KAUR<br>SHRI M. A. RUPEREE ( <i>Alternate</i> )         |

| <i>Organization</i>                                                           | <i>Representative(s)</i>                                                                                              |
|-------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| Ministry of Science & Technology, New Delhi                                   | SHRI RAJ KUMAR JOSHI<br>SHRI PAWAN KUMAR ( <i>Alternate</i> )                                                         |
| NBCC (India), Ltd, New Delhi                                                  | SHRI ANIL MALLA<br>SHRI M. K. CHAWLA ( <i>Alternate</i> )                                                             |
| National Test House, Kolkata                                                  | SHRI D. V. S. PRASAD<br>SHRI NARESH GUPTA ( <i>Alternate</i> )                                                        |
| NTPC Ltd, Noida                                                               | SHRI JITENDRA KUMAR<br>SHRI MOHIT JHALANI ( <i>Alternate</i> )                                                        |
| Public Works Department, Chennai                                              | SUPERINTENDING ENGINEER<br>EXECUTIVE ENGINEER ( <i>Alternate</i> )                                                    |
| Punjab Brick Kiln Association, Chandigarh                                     | REPRESENTATIVE                                                                                                        |
| Punjab State Council for Science and Technology,<br>Chandigarh                | SHRI PRITPAL SINGH<br>SHRI MAGANBIR SINGH ( <i>Alternate</i> )                                                        |
| Shriram Institute of Industrial Research, Delhi                               | SHRI RAJESH KUMAR<br>SHRI RAHUL ( <i>Alternate</i> )                                                                  |
| The Energy and Resources Institute, New Delhi                                 | SHRI SACHIN KUMAR                                                                                                     |
| Unique Engineering Testing & Advisory Services,<br>Surat                      | SHRI HITESH DESAI<br>SHRI NEHAL H. DESAI ( <i>Alternate</i> )                                                         |
| Wienerberger India Private Ltd, Bengaluru                                     | SHRI KUNDAN B. DIGHE<br>SHRI D. J. JAGADEESHA ( <i>Alternate</i> )                                                    |
| In personal capacity (651/37 Ganga Enclave,<br>Sainik Colony, Roorkee 247667) | DR J. M. BHATNAGAR                                                                                                    |
| BIS Directorate General                                                       | SHRI SANJAY PANT, SCIENTIST 'F' AND HEAD (CIVIL ENGINEERING)<br>[REPRESENTING DIRECTOR GENERAL ( <i>Ex-officio</i> )] |

*Member Secretaries*

SHRI MILIND GUPTA  
SCIENTIST 'C' (CIVIL ENGINEERING), BIS

AND

SHRIMATI DIVYA S.  
SCIENTIST 'C' (CIVIL ENGINEERING), BIS



## Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 2016* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

### Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

### Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

This Indian Standard has been developed from Doc No.: CED 30 (12844).

### Amendments Issued Since Publication

| Amend No. | Date of Issue | Text Affected |
|-----------|---------------|---------------|
|           |               |               |
|           |               |               |
|           |               |               |
|           |               |               |
|           |               |               |

## BUREAU OF INDIAN STANDARDS

### Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002

Telephones: 2323 0131, 2323 3375, 2323 9402

Website: [www.bis.gov.in](http://www.bis.gov.in)

### Regional Offices:

|                                                                                | Telephones                                     |
|--------------------------------------------------------------------------------|------------------------------------------------|
| Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg<br>NEW DELHI 110002          | { 2323 7617<br>2323 3841                       |
| Eastern : 1/14 C.I.T. Scheme VII M, V.I.P. Road, Kankurgachi<br>KOLKATA 700054 | { 2337 8499, 2337 8561<br>2337 8626, 2337 9120 |
| Northern : Plot No. 4-A, Sector 27-B, Madhya Marg<br>CHANDIGARH 160019         | { 265 0206<br>265 0290                         |
| Southern : C.I.T. Campus, IV Cross Road, CHENNAI 600113                        | { 2254 1216, 2254 1442<br>2254 2519, 2254 2315 |
| Western : Manakalaya, E9 MIDC, Marol, Andheri (East)<br>MUMBAI 400093          | { 2832 9295, 2832 7858<br>2832 7891, 2832 7892 |

**Branches :** AHMEDABAD. BENGALURU. BHOPAL. BHUBANESHWAR. COIMBATORE.  
DEHRADUN. DURGAPUR. FARIDABAD. GHAZIABAD. GUWAHATI.  
HYDERABAD. JAIPUR. JAMMU. JAMSHEDPUR. KOCHI. LUCKNOW.  
NAGPUR. PARWANOO. PATNA. PUNE. RAIPUR. RAJKOT. VISAKHAPATNAM.

Published by BIS, New Delhi